MASTER

XXII

The Persistence of Rainfall

Data

The book "A century of London Weather" gives the details of monthly rainfall at Greenwich (until 1870) and Kew (until 1949). By making a slight weighting adjustment to the Greenwich figures, a 100 year series (1850-1949) of monthly rainfall is obtained.

Method

The distribution of rainfall totals, expressed as a percentage of the 100 year average, was examined for each calendar month with reference to the rainfall of the previous 3 months, which in turn was expressed as a percentage of the 100 year average. This analysis was repeated with reference to the previous 4, 5 and 6 monthly totals. The results are shown in Tables 1, 2, 3 and 4. These tables show the difference between the

(a) percentage of months with rainfall below average (hereinafter called DRY) when the previous 3 (4, 5 or 6) months fell in the category stated at the head of the column

and (b) the percentage of months with rainfall below average when the previous 3 (4, 5 or 6) months fell outside this category.

A positive figure in these tables indicates there were more dry months than might be expected; a negative figure indicates that there were less.

Discussion

Examination of Table 1 discloses some interesting features which can be divided into two headings:-

Persistence

1. Dry Februarys tended to be more frequent after a 3 month dry period; wet Februarys followed a wet period
2. A similar characteristic is shown in August and September
3. After a moderately dry 3 months (60-99%), dry months have been more frequent than might have been expected in July, August and September (the "summer bloc")
4. After a very wet 3 month period (130% and above), there have been very much fewer dry months from January to September (with the exception of May)

Compensation

5. After a moderately wet 3 months (110-149%) there have been more dry months in March and April (the "spring bloc")
6. After a very dry 3 month spell, December has had fewer dry months than usual (the "early winter" bloc)

Table 2 confirms these features, for after a 4 month period we find:-

Persistence

1. February is still a 'lop-sided' month; wet months follow a wet period; the dry months after a dry period is now extended into January ("late winter bloc")
2. Dry after dry and wet after wet tendencies are now apparent in July as well as August and September
3. The "summer bloc" persists
4. The wet months after very wet periods now predominate from February to October.

Compensation 5. The "spring bloc" has weakened and now appears in May and June
6. The "early winter bloc" has strengthened slightly.

Table 3 continues the story; after a 5 month period we find:-

Persistence 1. The "late winter bloc" persists and has strengthened, February is still lopsided
2. The lop-sidedness of July, August and September has weakened
3. The "summer bloc" persists
4. The wet months after very wet periods now include the entire year except November

Compensation 5. The "spring bloc" still persists in May and June
6. The "early winter bloc" is now confined to December

Table 4 shows that these characteristics, although generally weaker, still remain after 6-month periods:-

Persistence 1. This effect still visible, chiefly in January; February is losing its lop-sidedness.
2. July and August still retain the lopsided structure
3. The "summer bloc" still persists
4. The very wet-wet sequence has at last broken down as a general feature and is only present in July to September.

Compensation 5. The "spring bloc" has disappeared
6. The "early winter bloc" is still there and again confined to December.

Numberical analysis

The apparently significant divergencies from normal expectancy of dry months are given in Tables 5, 6 and 7. From these it is clear that the most striking feature is the marked tendency to persistence in late summer.

From an agricultural point of view the apparent influence of the rainfall of the previous 3-6 months on the August rainfall is of great practical importance.

Table 8 emphasises this point. Under all types of circumstances the odds against a wet August, judging by past behaviour, are 11 to 9, and the odds against an outstandingly wet August are 5 to 1. After very wet weather in the previous months, these odds shorten to about 4 to 1 on for a wet August and an even chance of an August with more than 150% of average rainfall.

Conclusions

The tendency at Kew during the last 100 years for wet weather to persist in late summer, and to a lesser extent, for dry weather to persist, has been very marked and the best outlook for harvest weather is to assume such a persistence, rather than expect a change of weather type. These conclusions can be reasonably expected to hold true for south-east England, the Home Counties and possibly, East Anglia.

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Tables showing difference between percentage of dry months when the previous months fell inside a given category and the percentage of dry months when the previous months fell outside that category

Table 1.

	Percentage of average rainfall during the previous 3 months										
	Below 60	50-69	60-79	70-89	80-99	90-109	100-119	110-129	120-139	130-149	140 and above
January	+8	-11	-13	-7	+17	+25	+1	0	+24	-17	-25
February	0	+25	+16	+7	+10	+2	-5	-8	-22	-21	-11
March	-19	-1	+8	-7	-17	-2	+22	+12	+22	+25	-22
April	+24	+1	-11	+4	+1	-20	-6	+14	+26	+16	-19
May	+2	+7	-6	-16	-5	+8	+4	-9	-2	-3	+10
June	-11	-22	-7	+6	+15	+9	-1	+15	+8	+5	-29
July	-7	-14	+28	+37	+17	-13	-22	-15	+16	+2	-40
August	+13	+24	+14	+16	+21	+3	-9	-6	-10	-24	-37
September	+2	0	+8	+27	+24	+2	-11	-15	-3	-3	-29
October	-10	+9	+11	+6	-2	0	+1	-10	-14	+5	+9
November	+1	+3	+7	-1	-12	+3	+12	+8	-10	-22	+6
December	-13	-22	+4	+15	-7	-15	+4	+14	+6	+19	+10

Table 2

	Percentage of average rainfall during the previous 4 months										
	Below 60	50-69	60-79	70-89	80-99	90-109	100-119	110-129	120-139	130-149	140 and above
January	-11	+11	+12	+4	-1	+3	+13	+4	-26	-20	+15
February	+24	+29	+13	+7	-2	-5	+3	0	-12	-38	-25
March	+6	+9	-11	+5	+9	-4	+2	+3	-1	+6	-7
April	+16	-6	+18	+8	+4	0	-24	-12	-16	-28	+4
May	+14	+7	-4	-10	+8	-16	-17	+17	+22	+14	-16
June	+4	+13	-7	-13	-3	-8	+10	+21	+11	-7	-41
July	+16	+16	+20	+26	+1	+3	-8	-11	-3	-24	-29
August	+17	+6	+19	+23	+7	-9	-4	-6	-1	+2	-50
September	-3	+19	+4	+5	+17	+6	+4	-4	-14	-42	-32
October	-10	-5	-4	+7	+14	-7	-29	-4	+27	+19	-2
November	-5	-17	-4	0	+3	+16	+24	-15	-38	-17	+27
December	-15	-17	-16	-1	-3	+8	+22	+4	0	+3	-15

Table 3

	Percentage of average rainfall during the previous 5 months										
	Below 60	50-69	60-79	70-89	80-99	90-109	100-119	110-129	120-139	130-149	140 and above
January	+7	+15	+6	+8	+12	+7	-14	-20	0	+15	-14
February	+16	+16	+24	+18	-6	+3	+14	-22	-30	-17	-11
March	+11	-26	-24	+1	+9	+3	+3	+11	+7	-6	-6
April	+12	+14	+9	+8	+4	-3	9	-7	-10	-18	-21
May	-6	-5	-1	+2	-19	-10	+11	+15	+27	-1	-16
June	+9	-1	+1	0	-18	-10	+5	+6	+5	+4	-6
July	+12	+16	+27	+15	+3	-5	-11	-17	-12	+29	-14
August	+13	+23	+7	+11	+21	+12	-1	-6	-10	-39	-60
September	+15	+7	+7	+5	+14	+6	+2	+4	-19	-29	-37
October	+1	-19	+1	+14	+7	-13	-20	+5	+26	+17	-10
November	+12	-13	0	+3	-3	+4	+4	-2	-10	-20	+9
December	-26	-30	-29	-7	+9	+9	+13	+12	+4	+4	-7

Table 4

	Percentage of average rainfall during the previous 6 months										
	Below 60	50-69	60-79	70-89	80-99	90-109	100-119	110-129	120-139	130-149	140 and above
January	-3	+28	+28	+13	+4	-2	-27	-21	+12	+19	-14
February	+41	+12	0	+2	+2	+16	+11	-11	-26	-46	+7
March	-1	-12	-4	-5	+13	+10	+3	+12	-17	-17	-1
April	-2	+25	+27	+4	-6	-8	-8	-5	-13	-2	+4
May	-2	-19	-4	-3	-9	+7	+7	+17	+14	+1	-10
June	+4	+16	+15	+9	-16	-6	+11	-8	-25	+11	+12
July	+16	+24	+18	+14	-4	-6	0	-3	-18	-56	-17
August	+13	+23	+9	+15	+13	+14	+21	-6	-40	-60	-58
September	+48	+1	-14	+2	+10	+7	+1	-4	0	-17	-26
October	-41	-16	+22	+11	-2	-15	-17	+7	+44	+13	-5
November	+46	+6	0	-4	-5	-2	+1	+2	0	-5	+1
December	-7	-22	-27	-25	-2	+21	+24	+14	+4	-8	-7

Table 5

Eccentricities of rainfall distribution following a 3 month period of specified rainfall

Month(s)	Percentage of average rainfall in previous 3 months	Percentage of dry months following this category	Percentage of dry months all categories	Percentage of dry months outside this category	Chi-squared	Significance
January	90-109	72	53	47	4.85	.03
February	50-99	70	60	50	4.2	.04
March	100-139	80	61	53	6.47	.01
July	60-89	83	56	45	11.75	<.001
	90 and above	44	56	74	8.75	<.01
	140 and above	20	56	60	5.8	.02
	150 and above	0	56	59	6.7	.01
August	0-99	69	55	39	8.75	<.01
	130 and above	20	55	61	8.7	<.01
	150 and above	0	55	59	7.8	<.01
September	70-99	69	53	44	6.1	.015
	0-99	63	53	39	5.5	.02
	140 and above	29	53	58	4.56	.03
Jan. & Feb.	130 and above	39	56.5	59	3.9	.05
Jan. - April	140 and above	39	56.5	59	7.1	<.01
Mar. - April	110-149	70	56.5	51	5.4	.02
Jun. - Sept.	70-99	69	55	46	16.96	<.001
	140 and above	26	55	57	18.8	<.001
July- Sept.	60-99	69	54.7	40	19.7	<.001
	100-129	42	54.7	59	6.5	.01
July - Oct.	60-89	70	55.7	49	15.85	<.001
July - Dec.	60-89	67	55.8	51	12.35	<.001
Aug. - Sept.	0-99	68	55.5	40	15.9	<.001

Table 6

Eccentricities after 4 months

Month(s)	Percentage of rainfall in previous 4 months	Percentage of dry months following this category	Percentage of dry months in all categories	Percentage of dry months outside this category	Chi-squared	Significance
January	120-139	32	53	58	4.3	.04
April	100-149	34	52	61	6.7	.01
May	110-139	74	58	52	3.9	.05
June	110-139	70	56	49	3.8	.05
	140 and above	17	56	57	4.0	.045
July	less than 110	63	56	43	3.8	.05
August	less than 90	69	55	44	6.35	.01
	140 and above	10	55	60	9.1	<.01
September	120 and above	32	53	59	5.1	.025
October	100-119	35	59	64	4.75	.03
November	120-139	25	55	63	9.1	.01
	140 and above	89	55	52	4.6	.03
December	100-119	72	57	51	3.9	.05
Jan. & Feb.	120-149	38	56.5	61	6.4	.01
Jan.- April	120-149	43	56.5	59	5.7	.02
Feb.- Sept.	140 and above	34	56.4	59	15.1	<.001
April & May	100-119	41	55	60	5.3	.02
May & June	110-139	72	57	51	7.55	<.01
May-August	less than 70	69	56.2	54	9.5	<.01
May - Sept.	140 and above	24	55.6	59	16.75	<.001
July-Sept.	less than 100	63	54.7	45	9.7	<.01
July - Oct.	70-99	63	55.7	51	5.2	.02
Nov. - Jan.	90-119	63	55	49	5.8	.02

Table 7

(a) Eccentricities after 5 months

Months	Percentage of average rainfall in previous 5 months	Percentage of dry months following this category	Percentage of dry months all categories	Percentage of dry months outside this category	Chi-squared	Significanc
February	110 and above	42	60	69	6.3	.01
May	100-139	70	58	50	3.95	.05
August	110 and above	32	55	65	9.33	<.01
December	less than 80	35	57	67	4.9	.03
Jan. & Feb.	less than 90	66	56.5	51	4.2	.04
May & June	80-109	44	57	62	5.5	.02
Aug. & Sept.	120 and above	27	54	61	15.3	<.001
July-Sept.	less than 100	64	54.7	43	13.1	<.001
Feb.-Sept.	130 and above	41	56.4	59	11.9	<.001
Jan. - Oct.	140 and above	37	56.3	58	12.6	<.001
Jan. - Dec.	140 and above	40	56.3	58	10.4	<.01
		(b) Eccentricities after 6 months				
August	130 and above	0	55	67	11.3	<.001
December	less than 90	41	57	67	6.5	.01
"	90-129	70	57	43	7.6	<.01
June-Aug.	less than 90	65	55.7	51	5.5	.02
July & Sept.	120 and above	33	54.7	60	13.8	<.001
	130 and above	23	54.7	58	14.5	<.001

Table 8

Percentages of wet Augusts following months of various rainfall regimes

(a) Percentages of Augusts that were WET (100% of average or more)

Type of rainfall regime	Period of regime			
	3 months	4 months	5 months	6 months
Very dry (less than 70% of average)	30	36	27	29
Dry (70-99% of average)	32	34	36	39
Wet (100-129% of average)	52	50	45	40
Very wet (130% or more of average)	80	71	87	100
(b) Percentage of Augusts that were outstandingly WET (150% of average or more)				
Very dry	5	7	0	0
Dry	9	11	13	17
Wet	16	15	16	11
Very wet	53	50	47	58